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THE DIRECT REDUCTION OF IRON
AND THE LESS DEVELOPED AREAS

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THE DIRECT REDUCTION OF IRON AND THE LESS DEVELOPED AREAS

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1. Revolutionary changes will take place in the world steel industry in the near future in terms of world iron ore trade and through the construction of numerous small steel plants. Both of these changes will have their major impact on the less developed areas of the world. New technology will permit low capital investment direct reduction operations to be carried out economically and world trade in directly reduced iron ore will become practical. The rising tide of nationalism will result in the establishment of small local steel plants based upon directly reduced iron ore.

2. Iron units are consumed by the steel industry in 3 basic forms--iron ore, scrap and pig iron. The two most important in international trade are iron ore and scrap. The world steel industry consumes 500 million tons per year of ore, over 85 million tons is involved in international trade, considering ECSC as a single entity. With the expected tripling of steel demand by 1990, iron ore requirements will probably reach 1600 million tons per year. Scrap is abundant only in highly industrialized nations, and its availability is limited to a few million tons per year. It is not practical to base a country's steel industry upon a raw material so limited in supply.

3. A modern blast furnace plant, the conventional method for reducing iron ore, involves an investment of \$75 per annual ton of capacity and the minimum economic sized unit would produce 1,000,000 tons per year. Investment requirements for direct reduction plants of equal capacity are in the range of \$45 to \$65 per annual ton. The cost of producing melting stock via direct reduction varies from \$18 to \$25 per ton compared with pig iron costs of \$40 to \$50 per ton from the blast furnace. Melting stock can be compared with scrap--its value is less than molten pig iron--ordinarily at least \$30 to \$35 per ton f.o.b. source country--typically the United States. Utilization of directly reduced melting stock in the blast furnace would reduce blast furnace costs by decreasing coke requirements and increasing hot metal output. The advantage of carrying out the reduction near the mine is that it provides a means of exporting fuel and increases the value of ore from \$6 to \$9 per ton range to \$25 to \$35 per ton.

4. There are a number of direct reduction processes available. In general, these can be broadly classified into two categories--those that employ gaseous reductants derived from natural gas or petroleum deposits and those that employ solid fuels, usually noncoking coals or coke fines. A typical gaseous reduction process involves formation of suitable reducing gas from natural gas or fuel oil. This gas is heated blown through fluidized bed reactors counter-current to iron ore. The fluidized bed reactors are capable of handling large tonnages of ore continuously with high gas utilization efficiency.

5. The solid fuels direct reduction processes involve reduction in a rotary kiln type reactor of a mixture of solid fuel and ore. The kiln temperature is controlled by suitable fuel burners along its length.
6. The products of both general process categories are similar and typically contain 80 to 95% iron, depending upon the economics and dictates of the product market. The product can be agglomerated to appropriate sizes for shipment and for further iron or steelmaking.
7. Small steel plants will be justified in the less developed areas on several bases, both economic and political. These mills will require either scrap or a synthetic scrap raw material. World scrap resources are too limited, thus direct reduction will provide the material for such mills. A small steel plant could operate on a fractional portion of the product from a large scale direct reduction operation supplying melting stock to world markets or if local raw materials were not available a small local mill could purchase the necessary synthetic scrap from countries with large scale direct reduction operations. Such small mills would save foreign exchange, provide employment, create new industry, etc.
8. The small local steel markets could consist of a small direct reduction unit scaled to meet the individual plant's requirements as many of the direct reduction processes can be scaled down and yet operate efficiently. The directly reduced product would be melted in steelmaking furnaces, probably electric, cast into billets or continuously cast and then fed directly to a merchant rolling mill capable of producing perhaps 60% of the less developed country's requirements for steel.